INJURIES TO THE AXILLARY VESSELS OCCURRING DURING OPERATIONS FOR CARCINOMA OF THE BREAST.

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RECENTLY, while operating for carcinoma of the breast, in severing the pectoralis minor and the underlying fascia from the coracoid, I accidentally drew the axillary vein into the bite of the scissors. As a result, a transverse cut, involving about a third of the vessel's circumference, was produced. A catgut ligature, completely occluding the lumen, was at once placed above and below the defect, and the operation proceeded in the usual way. An uneventful recovery followed, no circulatory disturbance of any kind being noted. The patient was seen for the last time three weeks after operation.

Upon seeking information in regard to similar injuries, I found very little that was satisfactory. The text-books mentioned the subject only in a casual way, and a review of the articles on carcinoma of the breast published during the last five years gave little bearing on it. Thinking that the collective experience of a number of operators would be of interest and of value in determining the results of such injuries, I sent a letter to a considerable number of American surgeons asking for the number of cases which they had, which vessel was injured, how the accident occurred, how it was treated, and what was the result. I received replies from seventy-one. Of these, forty-four had never injured the axillary vessels; twenty-seven reported one or more cases.

The following are abstracts of the letters received:

BECK, CARL, New York. One case in which there was an extensive glandular enlargement in the axilla, the vein being embraced by the glands. "There was some technical difficulty,

but the case did well." He has had to ligate the vein four or five times, never the artery.

BLOODGOOD, JOSEPH C., Baltimore. We have had 300 or more complete operations. As far as I can recollect, there has not been a single injury to the artery. On a few occasions, two or three, the vein has been torn, but in each instance immediately sutured. We have had therefore no complications whatever from injury to vessels. On four or five occasions we have deliberately excised large portions of the vein because a gland or two was adherent. There have been no complications following such a dissection. In a careful denudation of the axilla for cancer of the breast, I am inclined to think that injury of the axillary vein or artery should be a very rare accident. Adhesions to the vein and artery are present only in a slight number of cases, and even here, if the dissection is carried on slowly and carefully, a complete operation may be performed without difficulty.

BULL, WILLIAM T., New York. He has no notes of such cases, but recalls indistinctly having once cut the axillary vein nearly across in dissecting away some adherent glands. No ill results followed.

COE, HENRY C., New York. He has seen the axillary vein punctured in dissecting out the sheath in three or four cases without bad results. In one of these cases the vein was ligated, in another it was tied at the side without occluding the lumen.

DEAVER, JOHN B., Philadelphia. He has injured the axillary vein in a number of cases, and has repaired the injury by a lateral ligature. He has excised a portion of the axillary vein in bad cases. When it is difficult to practise lateral ligature or when there is some uncertainty about its retention, he puts on a forceps which does not occlude the lumen; this forceps is removed the third day. He has always had good results, both immediate and ultimate, in all his cases.

GERSTER, ARPAD G., New York. "Numerous instances." He has never injured the vein accidentally. Avoids this by a very free exposure of the field and of the large vessels above and below over the region holding close relation with the tumor. Never dissects separate adherent glands from the axillary vein, but prefers to excise the adherent portion of the vein in one piece with all fatty and glandular contents of the axilla, this being done, of course, after preliminary double ligature of the vein above and

below the parts to be excised. No ill consequences following the interruption of the venous current. A slight œdema occurred very rarely. Healing progressed normally.

HARRINGTON, FRANCIS B., Boston. Harrington has once or twice cut off one of the branches so close to the axillary vein that it has been necessary in tying to diminish the size of the lumen in the main vessel, but without actually occluding it. He has never recognized any bad results from this cause. He believes that the vein can be sutured with fine silk without producing a thrombus or interfering with the blood current.

HENROTIN, FERNAND, Chicago. Out of probably 150 cases of cancer of the breast, he has never torn the vein wide open. A few times he has injured it so that it gave rise to a good deal of hæmorrhage, but he has been able to catch the tear with a Billroth forceps and to throw a fine catgut ligature around it sufficiently secure to stop the hæmorrhage. No mention of results was given.

JEWETT, CHARLES, Brooklyn. He has never injured the axillary vessels directly. In two cases marked œdema developed several weeks after operation, and he believes that this came from obstruction to the vein caused by contraction of scar tissue. The œdema was permanent. In both these cases the patients died from metastatic growths.

McBURNEY, CHARLES, New York. One case. Case of recurrent carcinoma of the axilla. Deliberate and intentional resection of about two inches of the axillary vein. Enlongated mass of carcinomatous tissue entirely surrounding and densely adherent to the vein. Vein ligated above and below and intervening section removed. Recovery uneventful. Œdema of the arm expected, but did not occur. McBurney remarks that the arrangement of the veins is really so varied that the ligature of what appears to be a full-sized axillary may cause little or no interference with the current. Modern aseptic methods have done much to remove the danger which formerly existed when the axillary vein or artery was ligated.

MARCY, HENRY O., Boston. Two cases of suture of the axillary vein without untoward result, the circulation being unimpaired after the suturing. He uses a very fine kangaroo tendon continuous suture. A double continuous suture preferred where it can be easily applied. Suture applied in such a way as to leave

the inner surface of the vein smooth. He has also applied this method to the common iliac and twice to the femoral vein. All his injuries were accidental. In all he has had good results, the circulation being undisturbed.

MAYO, W. J. and C. H., Rochester, Minnesota. Have twice injured the axillary vein and once the subclavian. Two cases were treated by a suture of fine catgut, the wall of the vein was puckered up considerably, but no trouble followed. The third was a lateral ligature applied to cover a defect made in the main vessel by cutting off a branch close to its wall. The ligature was applied with a needle to prevent slipping. No swelling of the arm occurred in any of these cases.

MEYER, WILLY, New York. One case. A patient with far advanced axillary involvement. Resection of the vein seemed contraindicated. The long thoracic vein tore off just at its entrance to the axillary vein during the attempt to loosen the glands from the vessel. The bleeding point was grasped with mouth-toothed artery forceps. By pulling the lower wall of the vein downward and upward he succeeded in placing a lateral ligature. Patient recovered.

MONTGOMERY, E. E., Philadelphia. One case. Controlled by lateral ligature. The accident was produced by dissecting off some glands which lay directly on the surface of the vein. Patient subsequently had gangrene of the thumb on the opposite hand, from which she died.

MORRIS, ROBERT T., New York. Two cases of tear in the axillary vein,—one was small and was closed with purse-string suture; the other was nearly one-half an inch long and was closed with running catgut. Both patients made a good recovery. He states that it is a common thing to see some swelling of the arm on account of the removal of lymph vessels, and that one would have some difficulty in determining if any part of the swelling was due to the interference with venous return.

MURPHY, J. B., Chicago. Two cases. One, a tear with the finger, producing a considerable opening in the vein. This was done while endeavoring to separate a firm adhesion from the gland which was the seat of a "mixed infection." In the other case the injury was done with the scissors, he not having recognized the wall in its location, compressed between two large glands. In each of these cases he made a continuous suture with

catgut, and in each there was recovery without thrombus so far as could be determined by the circulation of the arm. The largest laceration of the vein which he ever made was by putting his entire thumb into the subclavian in removing firmly attached tuberculous glands. There was a gush of blood when the thumb was removed. It was immediately reinserted, and kept there while he grasped the edges of the vein at one angle with forceps and kept applying one forceps after another until he had five of them on the rent. When the thumb was entirely withdrawn, the vein was closed by an over-and-over stitch with catgut, the threads passing between each of the forceps, the thread being pulled taut as the forceps was withdrawn. Patient made an uneventful recovery. This occurred shortly after his experimental work with arterial suture, otherwise he believes he would have had a serious time with his patient.

NANCREDE, CHARLES B., Ann Arbor, Michigan. Case 1. Recurrent axillary growth. Injury to the axillary vein. The vein secured with some difficulty between two ligatures. No harm resulted. Case 2. Recurrent axillary growth. Injury to the axillary vein or the subscapular vein close to the main vessel; thinks the former. Secured by ligation after considerable bleeding.

OCHSNER, A. J., Chicago. He has many times injured the axillary vein by cutting off one of the branches too close to the main vessel during dissection. The main vessel has been torn a little in trying to catch and ligate the bleeding point. In one case, having torn into the axillary vein and having attempted to place a lateral ligature, he was obliged to ligate the whole vein. There was some œdema of the arm for one month, after which the trouble disappeared without leaving any bad effects.

PARK, ROSWELL, Buffalo. Two cases. Park has twice applied sutures of fine silk to injuries to the axillary vein, and once has left hæmostatic forceps on either the axillary or subclavian, he could not exactly tell which, but thinks the latter, because he was working through an opening near the clavicle. All three cases did well. In the case in which forceps were used, they were removed in forty-eight hours without further hæmorrhage.

POWERS, CHARLES A., Denver. Has been obliged to completely ligate the axillary vein three times, and in six or eight

other occasions has put on a side ligature. He has never had definite trouble follow.

RICHARDSON, MAURICE, Boston. In probably 500 dissections of the axilla he has been obliged to resect the vein two or three times. This was made necessary by the disease. When there was simply an injury to the axillary vein, he has been able to make a satisfactory suture. There were no ill consequences in any of his cases.

SENN, NICHOLAS, Chicago. Several cases in which the vein was excised. A passive œdema was the only immediate ill result.

STONE, ISAAC S., Washington, D. C. One case. One of the branches of the axillary vein torn from the main vessel. A clamp applied to the tear and a ligature carefully placed in order not to include much of the large vein and occlude its lumen. A slight swelling of the arm occurred. Patient made an excellent recovery.

VAN HOOK, WELLER, Chicago. Has several times injured the axillary vein, and has succeeded in putting on a lateral ligature except when the vein was involved in growing carcinoma, and when in consequence a portion of the vein had to be removed. He has never seen any ill results. He does not think that injuries to the walls of large veins in aseptic wounds are feared by experienced surgeons. He believes such injuries are of common occurrence, and, in the absence of suppuration, are followed by no ill consequences.

WARREN, J. C. (by Walter B. Odiorne), Boston. One case. Carcinoma of the breast with involvement of axillary and cervical glands. Both axillary and supraclavicular glands were removed. Two years later, during a secondary operation for the removal of an enlarged gland just above the clavicle, this being the first sign of recurrence, an injury occurred to the subclavian vein. The clavicle had been previously divided. The profuse hæmorrhage was controlled by tying both ends of the divided vein. Absolute rest of the arm for several weeks, during which time there was considerable swelling; but this subsided, and patient regained entire use of arm. Died one year later of "general recurrence." The presence of old scar tissue, which made the dissection very difficult, was the cause of the accident.

CUSHING, ERNEST W., Boston. One case. Was present when one of his assistants, in attempting to remove a malignant

growth from the axilla, punctured the artery. There was a tremendous gush of blood; the subclavian artery was compressed, and he applied a clamp to the injured vessel. The clamp was left in place eight days. As the injury was high up in the course of the artery, it was deemed best not to apply ligature, but to allow the forceps to remain, since it controlled the hæmorrhage perfectly. The arm became pulseless and was somewhat swollen. It was kept warm artificially. The recovery, as far as the arm was concerned, was quite satisfactory; but the patient lived but two months, dying of extension of the malignant disease into the pleural cavity.

McArthur, L. L., Chicago. Has never injured the axillary vessels during operation for cancer of the breast, but once saw the artery cut, together with one branch of the brachial plexus, in an operation by his house surgeon on a child two years old. The operation was undertaken for tubercular glands of the axilla, secondary to vaccination. In this case the collateral circulation was sufficient to maintain the circulation in the arm. The final outcome of the accident to the nerve is not known.

Meyer, Willy, New York. One case. During an operation for recurrent, glandular, axillary carcinoma, after amputation of the breast, the long thoracic artery was torn away from the main vessel close to the latter's wall. An attempt was made to suture the vessel, but the arterial wall yielded so little that he deemed it wiser to ligate the artery above and below the bleeding point and divide between the ligatures. With elevation of the arm during after-treatment, the patient recovered without any trouble, and could use the extremity during the remainder of her life.

Murphy, John B., Chicago. Has never injured the axillary artery during the operations for cancer of the breast, but had a bullet wound of the first portion of the axillary artery just beneath the clavicle. Resected the artery and invaginated the proximal into the distal end with silk sutures. There was immediate return of pulsation of the radial, and the patient recovered without serious disturbance of the circulation of the arm, and has remained well.

Richardson, Maurice, Boston. One case. Operation for malignant disease. A part of the lumen of the artery was destroyed. The hole in the vessel was closed with two or three

sutures. No bad results followed. There was never aneurism. The woman died some time later with recurrence of the cancer.

It was my original intention to tabulate the cases reported, but this was impossible, since the answers, given usually from memory, were often incomplete; the exact number of cases and the particular line of treatment applied to each case being oftentimes unknown. On reading over the replies, however, certain facts stand out distinctly, and, as these are the important ones, a word of comment may not be out of place.

Vein.—There are sixty-three cases of injury to the vein reported. This is estimating the expressions "several," "a few," "a number of" to mean three, and "many," or "in numerous instances" to mean four,—as conservative a way of counting as possible. In no case did permanently bad results follow injury to the vein,* whether the vein was *wholly* or *partially* occluded with the ligature or forceps. In some cases an œdema of the arm is reported; this is usually of slight degree and transient. Air embolism did not occur, nor did any septic trouble arise from the resulting thrombosis of the vein. It must be remembered that these operations were done under aseptic technique. The results of vein injury were not as good before the establishment of modern methods.

The cause of injury seems commonly to have been a more or less extensive adherence of cancerous lymphatic glands to the vein wall, making an injury to the vein an easy or unavoidable consequence. Where such a condition was found, Gerster states that he never dissects away such glands, but prefers to excise the adherent portion of the vein after double ligature. This plan was carried out by several others. A considerable number of cases occurred during a secondary operation, an operation which would imply considerable malignant disease in the axilla and usually scar tissue from the previous operation.

* See Jewett's letter. As complete occlusion of the vein at time of operation is rarely followed by swelling, it would seem that this phenomenon, which is not very uncommon, would call for further explanation.

An injury naturally would be more likely to follow. Actual occlusion of the vein was often deliberate and made necessary by the extent of the disease. Slight injuries occurred accidentally. Pricking of the vein wall with a needle was reported frequently; a tearing of the vein wall was common. Tearing away one of the branches of the vein was also a common occurrence.

Treatment.—In order to prevent injury to the vein, a very free exposure is commonly advised and practised. Great care in manipulation while removing the axillary contents, especially where glands are extensively involved and adherent, is imperative.

Where the injury was slight, an attempt was always made to apply some form of lateral ligature or forceps. The vein was either picked up with a forceps and a lateral ligature applied on a needle or otherwise, or a running suture was made. Marcy lays considerable stress on the use of a fine kangaroo tendon, leaving the inner surface of the vein smooth. He has applied this method to the common iliac and twice to the femoral, and has always had good results, the circulation being undisturbed. By others both catgut and silk have been employed, apparently with the same good results. A forceps left on for about forty-eight hours was used by Deaver, Henrotin, Stone, and Park. When actual occlusion was necessary, a ligature was simply thrown around the vein above and below and tied; the intervening portion was sometimes cut away with the diseased tissue.

Artery.—Injuries to the artery are naturally much rarer than those to the vein. This is undoubtedly due to the less exposed position of this vessel, the strength of its walls, and its easy detection while working near it. As with the vein, the injury may be so slight as to suggest closing the defect without occluding the lumen, or it may be such as to make closing the artery imperative. In none of the three cases occurring during operation for cancer of the breast, nor in the two cases undertaken for other purposes, was there serious disturbance to the circulation. Murphy's case of invagination is of interest. A possible complication of the injury to the axillary artery would

be an accompanying injury to one of the main nerve trunks, which lie so close to the artery. This occurred in McArthur's case. Cushing describes the hæmorrhage as being most alarming, and does not wish to have the experience repeated. The material is too meagre to deduce accurate conclusions therefrom, but we may at least say that injury to the axillary artery is not necessarily serious.

Summary.—Injuries to the axillary vein occurring during operations for cancer of the breast, performed under aseptic methods, are in no way serious. A passive œdema of the arm rarely occurs, and when it does is slight and transient. Slight injuries may be repaired by a lateral ligature or a running suture. A forceps left in place forty-eight hours may be used where the application of a suture is difficult. Where injury to the vein is extensive or when the situation of diseased tissue makes it desirable, it may be boldly tied above and below and the lumen occluded without fear of bad results.

As to injuries to the artery, the material is too meagre to allow of definite conclusions. There was no permanent bad result in the five cases reported. Artificial heat during recovery of circulation seemed necessary in the cases where the artery was occluded.